PHMSA Research Project
DTPH56-08-T-000012

IMPROVEMENT TO THE ECDA PROCESS:
Potential Measurements on Paved Areas

PHMSA Advisory Committee Meeting – Dec. 10, 2009

GOAL – Potentials In Paved Areas

- **Current Procedures:**
  - Drilling through pavement every 5-10 feet (most prevalent)
  - Offset measurements in adjacent unpaved areas
  - Surface wetting (varying degrees of success)
  - Skip paved areas completely

- **Goal – New/Improved Tools/Methods:**
  - More reliable data
  - More efficient, safer
  - User-friendly
  - Applicable to LDCs and transmission operators alike
  - Ultimately promotes more surveying in paved areas, thereby improving pipeline integrity

SCOPE - Potentials In Paved Areas

- **Three Paving Types:**
  - Asphalt
  - Concrete
  - Gravel
- **Primary Research Activities:**
  - Literature search / interviews / data mining
  - Laboratory tests
  - Field tests
  - Develop procedures
  - Final Report
- **Presentations on Research:**
  - NACE Corrosion Technology Week (9/09)
  - American Gas Association (9/09)
  - NACE International (3/10)

corrpro®

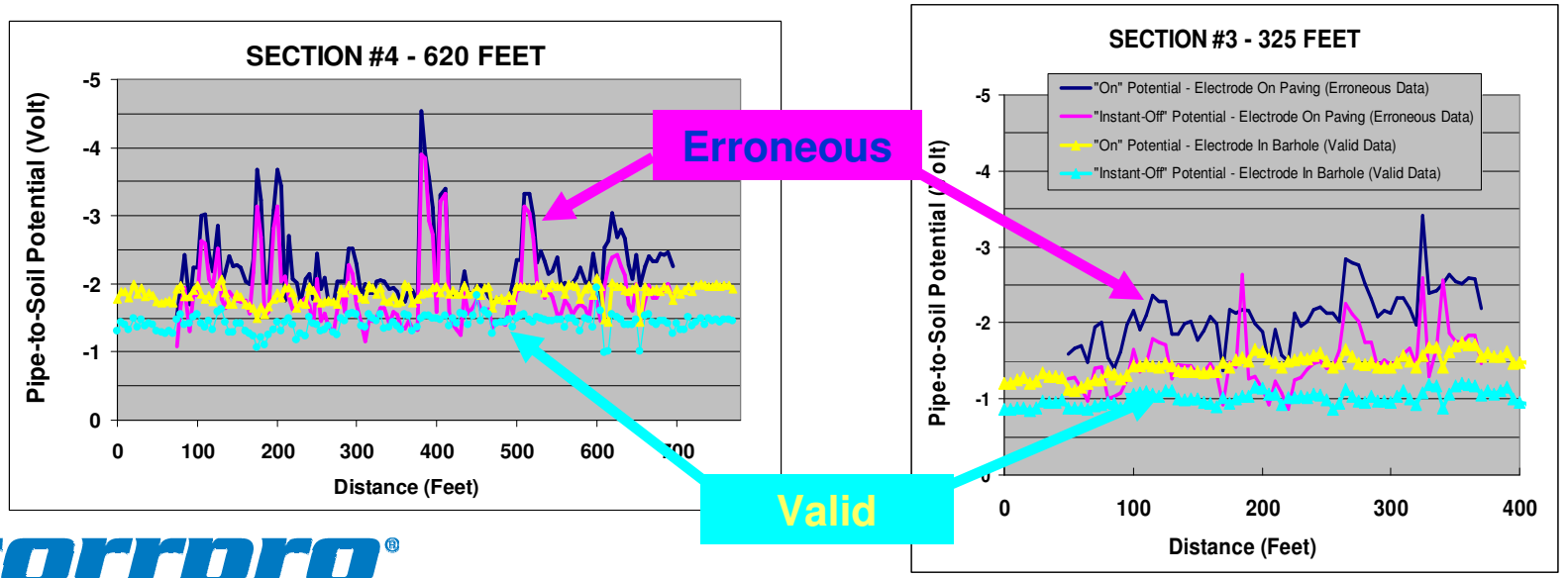
SCOPE - Potentials In Paved Areas

	Work Element / Milestone	Completion (Months after Start)
1	Literature Search	3
2	Controlled Tests	6
3	Develop/Refine Prototype Tools/Methods	9
4	Field Trials / Verification	12
5	Implement Tools/Methods With Research Partners & Improve As Needed	15
6a	Field Re-Validation & Further Refinement As Needed	18
6b	Development of Go / No-Go Point & Written Procedures	18
7	Prepare Draft Report	21
8	Prepare Final Report & Draft Industry Standard	24
8a	Web-Based Workshop	TBD
8b	Papers/Presentations	TBD

corrpro®

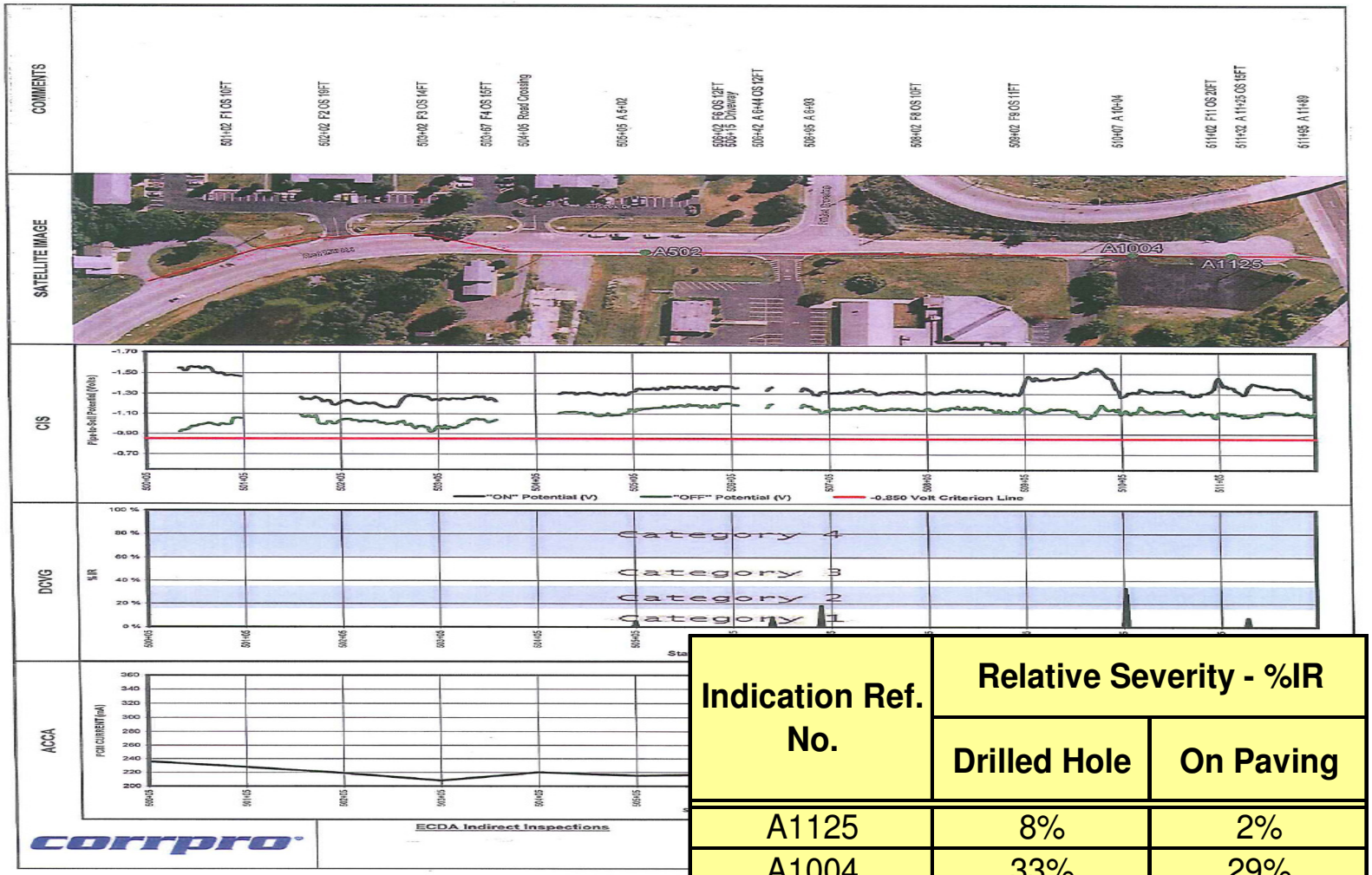
New York City: Natural Gas LDC

- 8-miles Interrupted CIS/DCVG annually on paving, predominantly asphalt (wide range of age, thickness, and sub-bases not determined)
- Light surface wetting at reference electrode immediately prior to placement
- Techniques successfully used for several years
- 93% effective data as-measured with reference electrode on paving (2007 survey year)
- 7%, 13 areas totaling 0.5-mile required repeat measurements using bar-holes through paving (2007 survey year)



corrpro®

Corrpro CIS & DCVG On Recently Paved Road



Indication Ref. No.	Relative Severity - %IR	
	Drilled Hole	On Paving
A1125	8%	2%
A1004	33%	29%
A502	5%	4%

corrpro®

Research Direction Based on Initial Activities

POSTULATION:

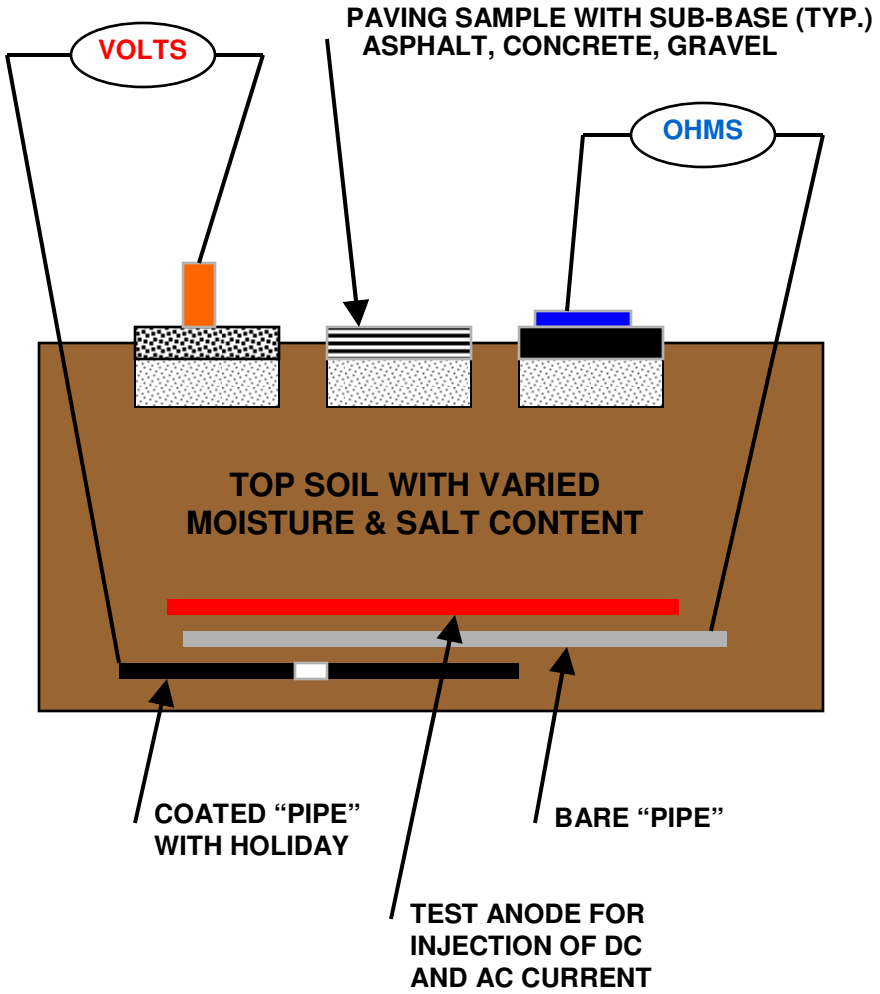
If basic electrical measurements could characterize a pavement, then decisions and guidelines regarding the validity of potential measurements with reference electrodes on the paved surface could be made.

- Asphalt – Resistance Measurements
- Gravel – Resistance Measurements, Validation “Holes”
- Concrete – Correction Factor?

As the research has progressed, this postulation has been tested and refined. The result is a simple field test procedure that can be used at the onset of a potential survey to determine if on-paving measurements can be made accurately.

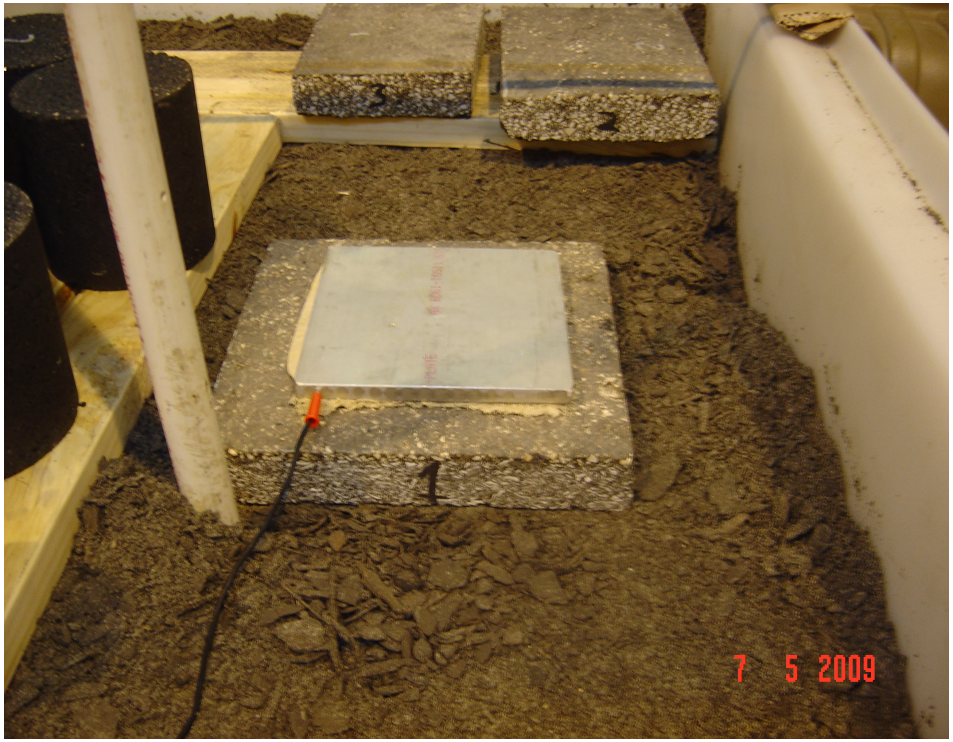
corrpro®

“Bathtub Tests”

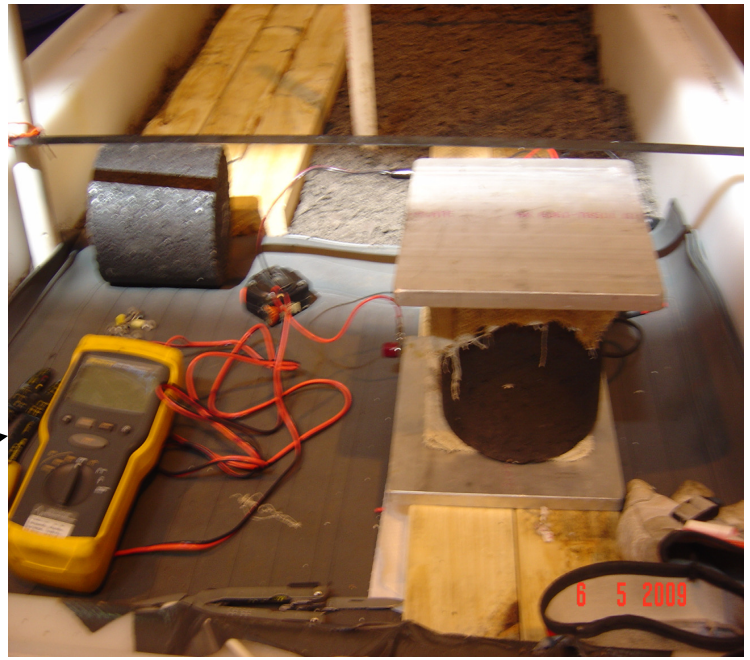


corrpro®

Asphalt Resistance / Resistivity Measurements

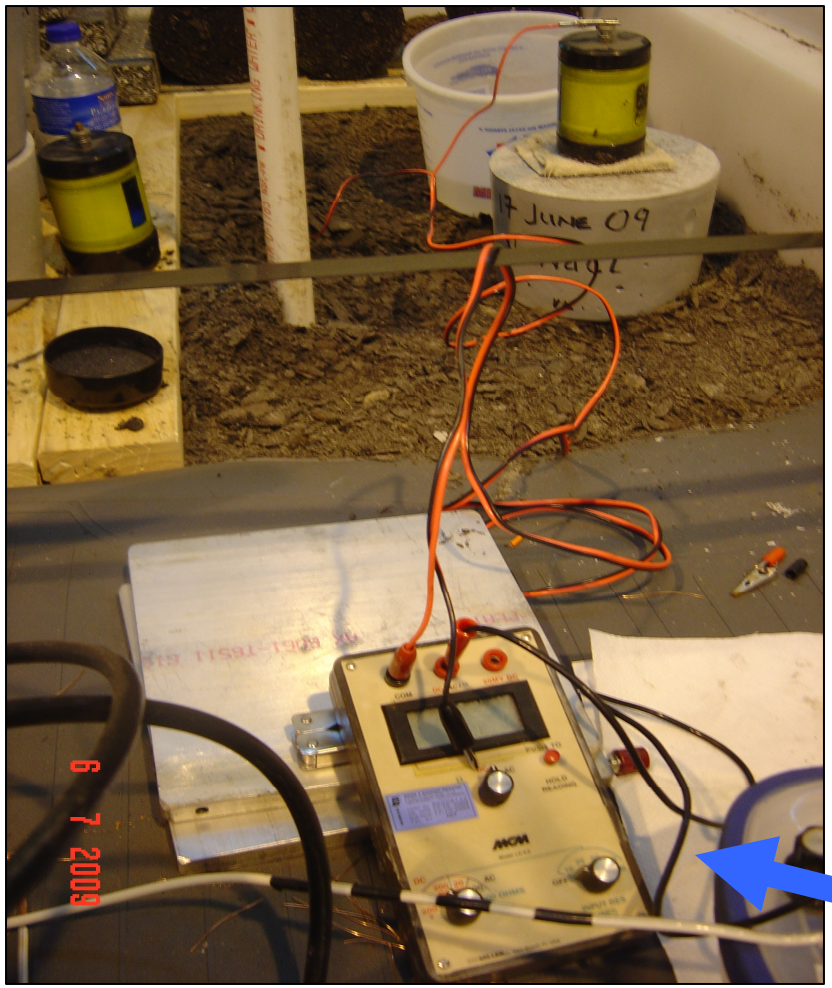


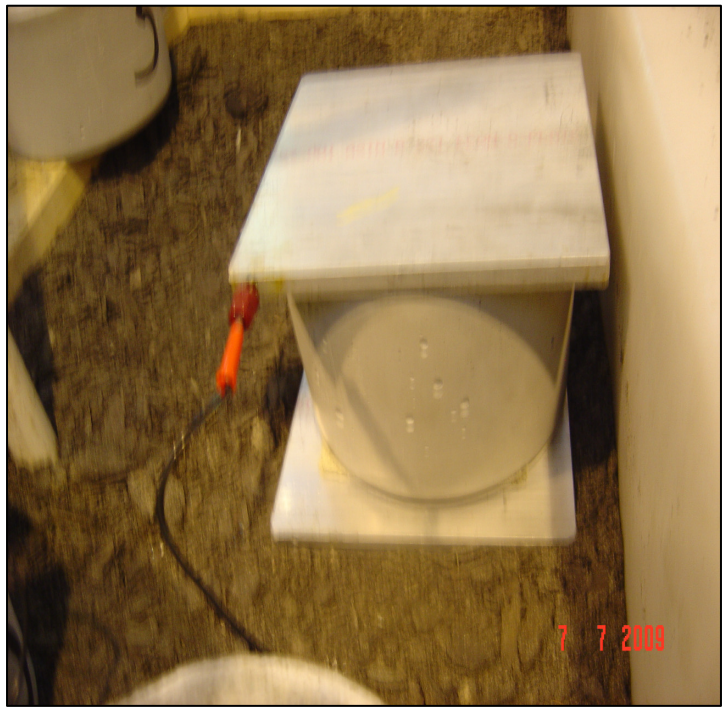
Megohm Resistance Meter
1,000 Volt Max. Source Voltage



corrpro®

Concrete Potential & Resistivity Measurements

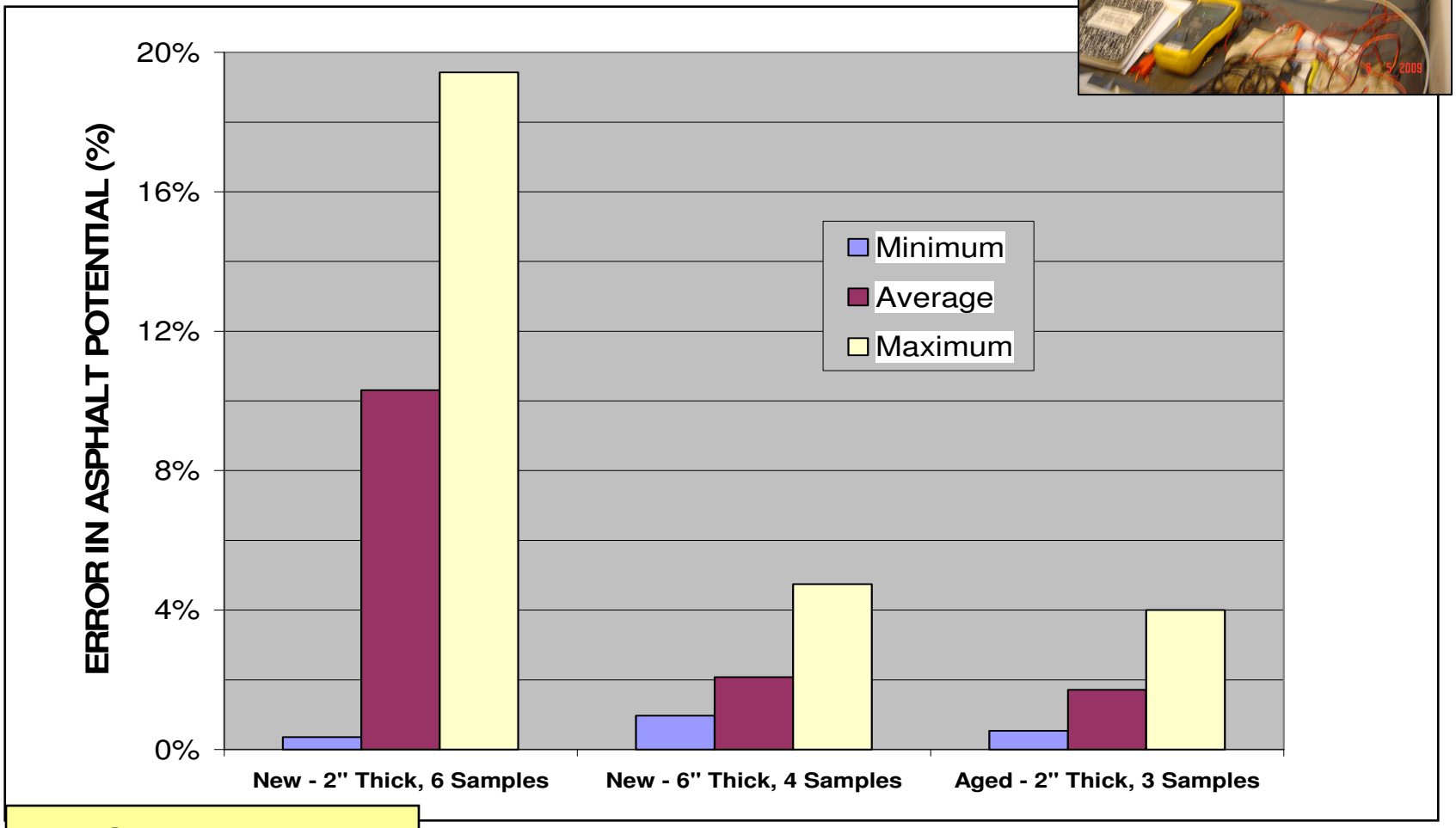




Digital Voltmeter with Variable Input Resistance to 200 Megohm

corrpro®

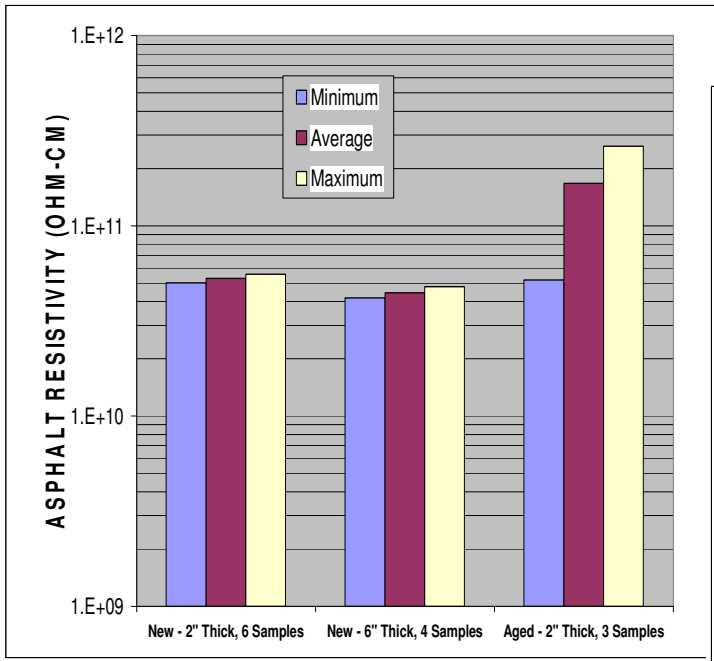
"Bathtub Tests": ASPHALT

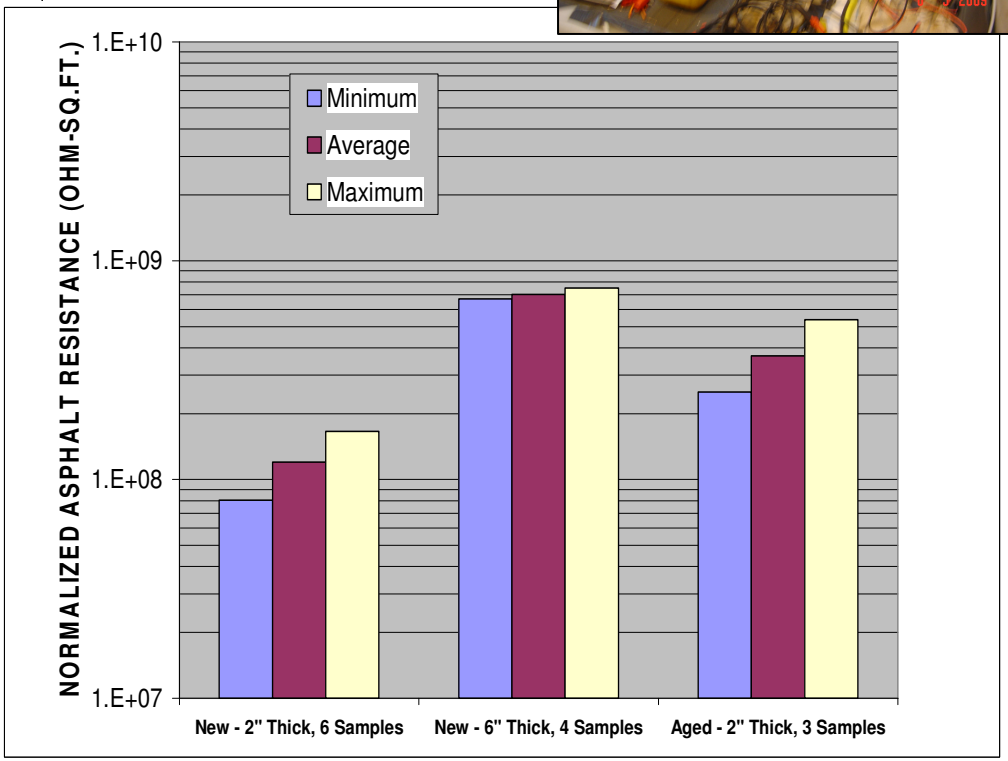


POTENTIAL

corrpro®

"Bathtub Tests": ASPHALT





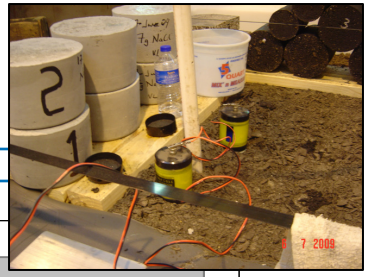
Resistivity:

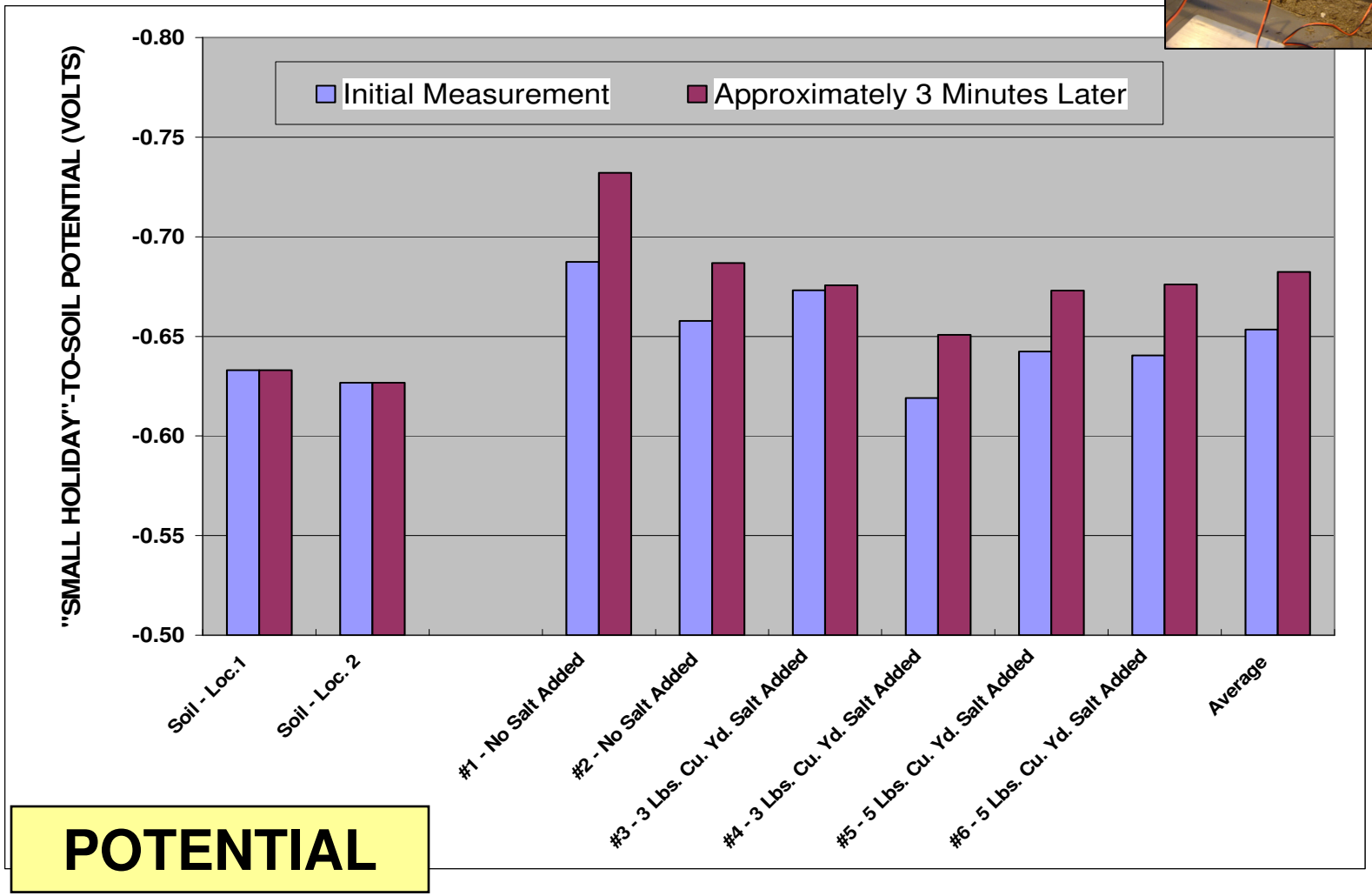
ρ (ohm-cm) = R_{meas} (ohms) x Area ÷ Thickness

Normalized Surface Resistance (independent of thickness):

R_{norm} (ohm-ft^2) = R_{meas} (ohms) x Area

"Bathtub Tests": CONCRETE

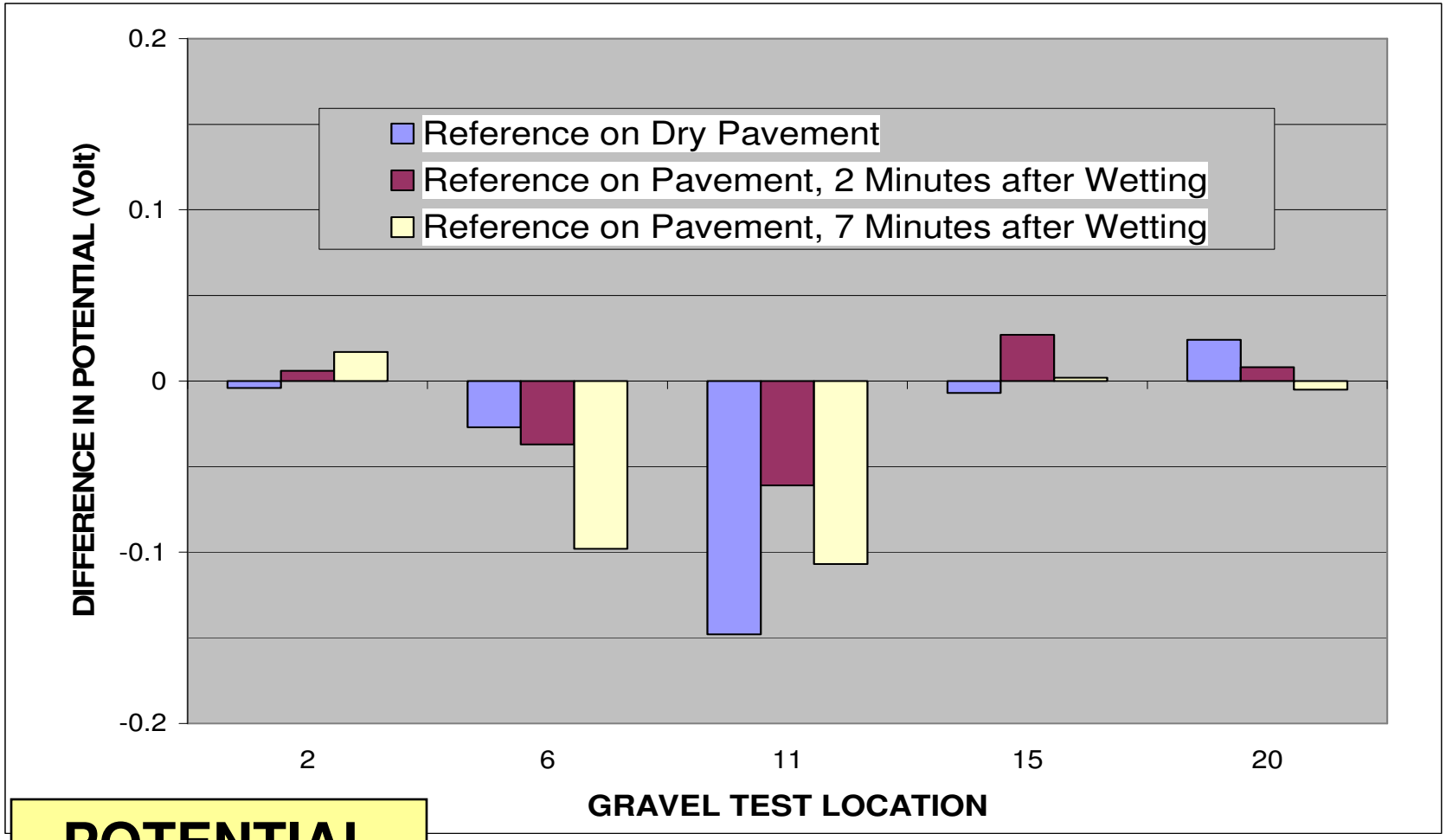




POTENTIAL

corrpro®

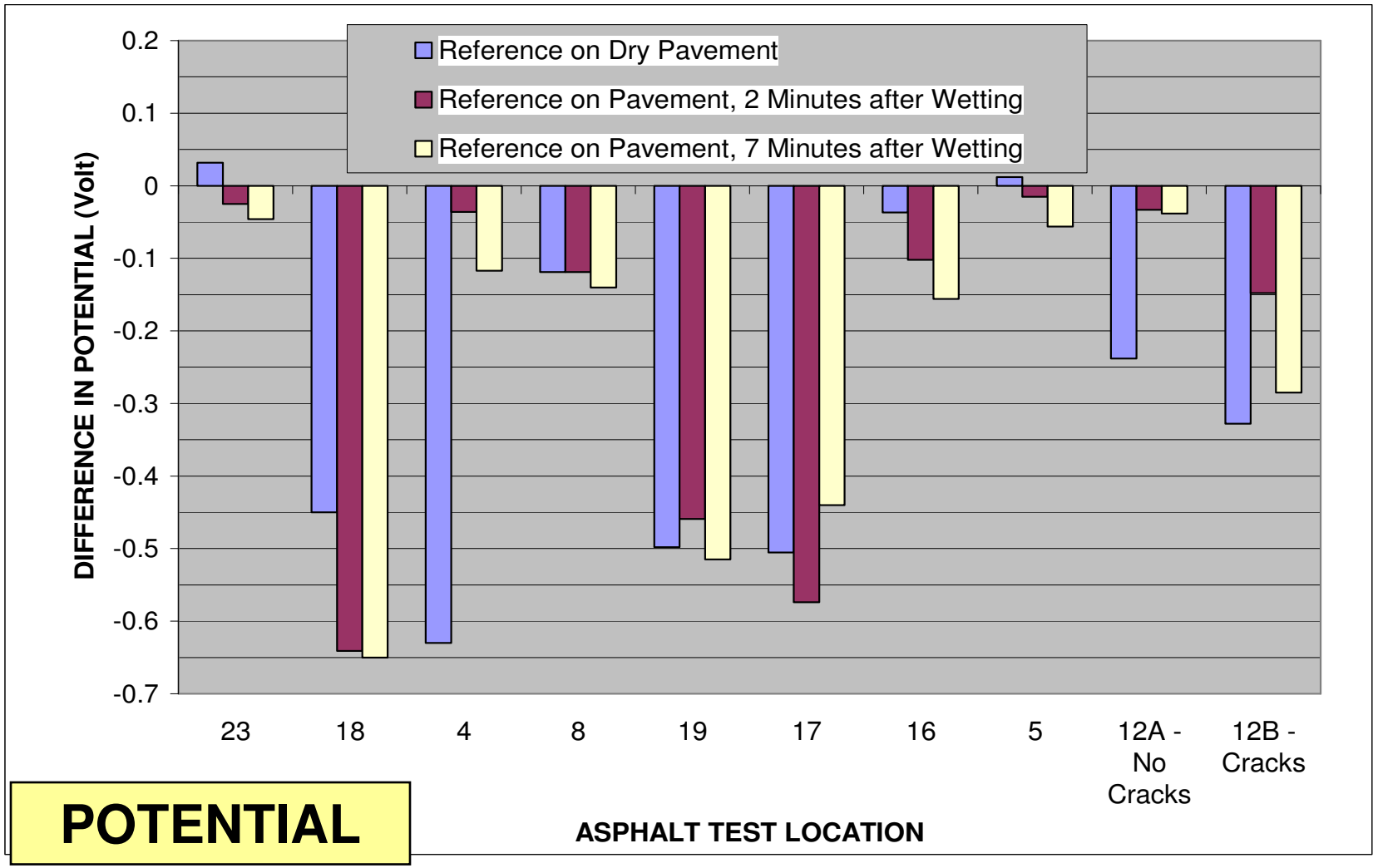
Characterizing Pavement – Field Tests: GRAVEL



POTENTIAL

corrpro®

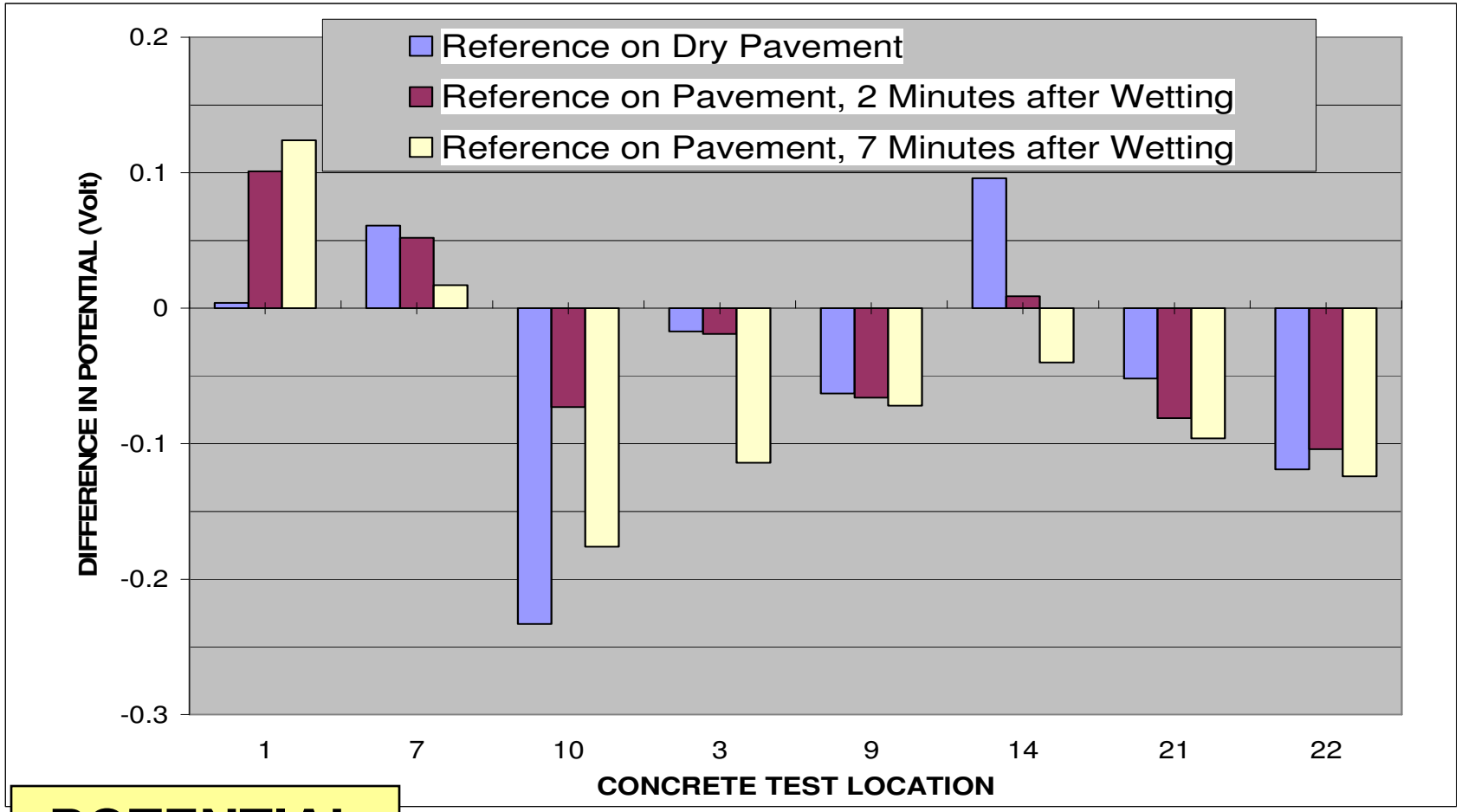
Characterizing Pavement – Field Tests: ASPHALT



POTENTIAL

corrpro®

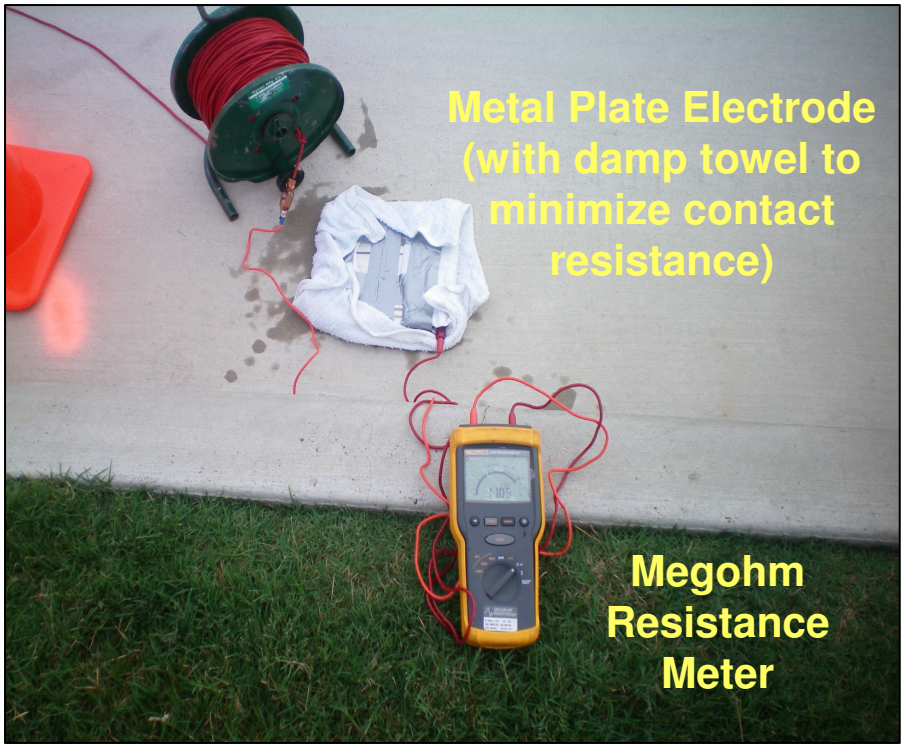
Characterizing Pavement – Field Tests: CONCRETE



POTENTIAL

corrpro®

In-Situ Surface Resistance Measurements



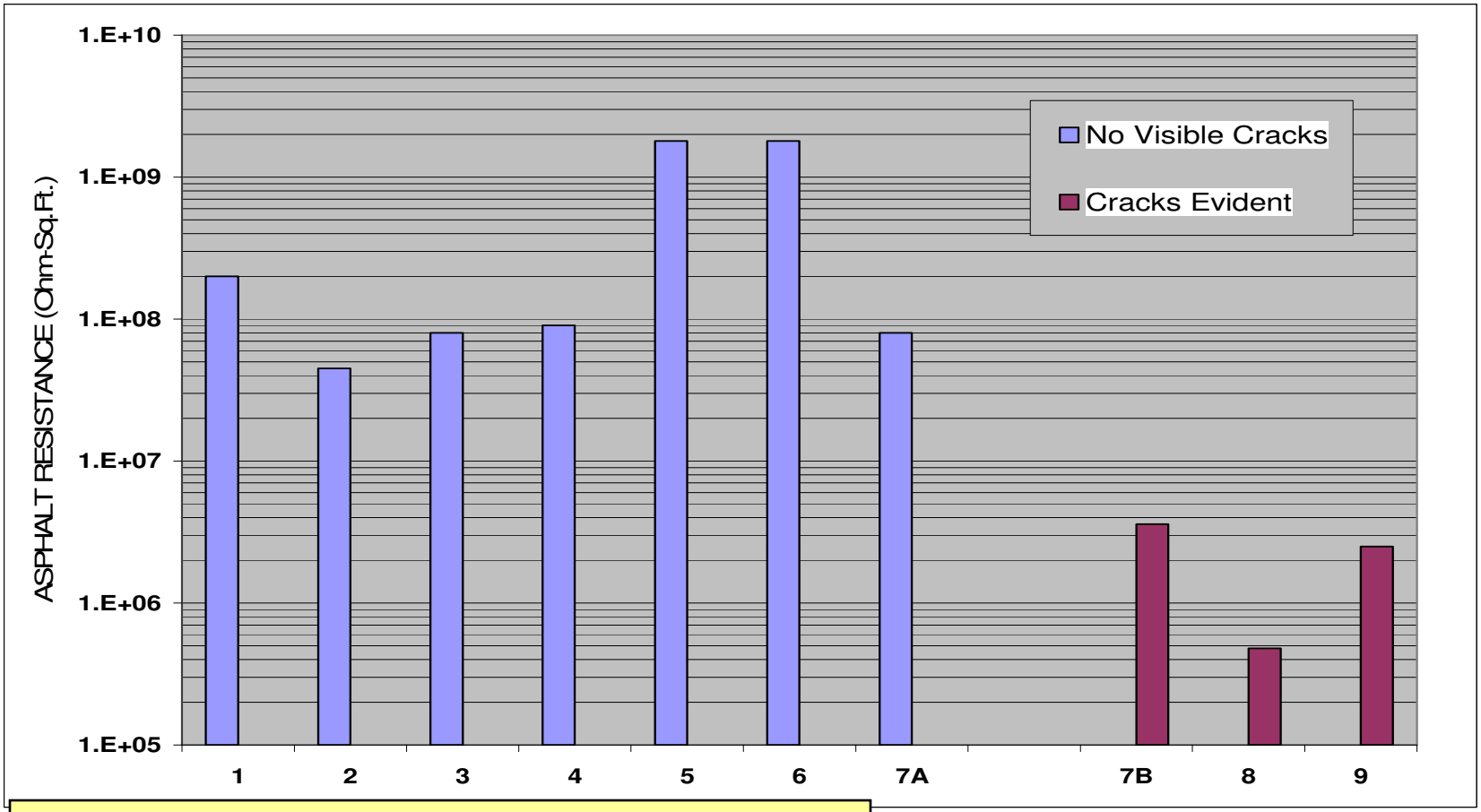
Less than 5 minutes per test

Normalized Surface Resistance (independent of thickness):

R_{norm} (ohm-ft^2) = R_{meas} (ohms) x Area

corrpro®

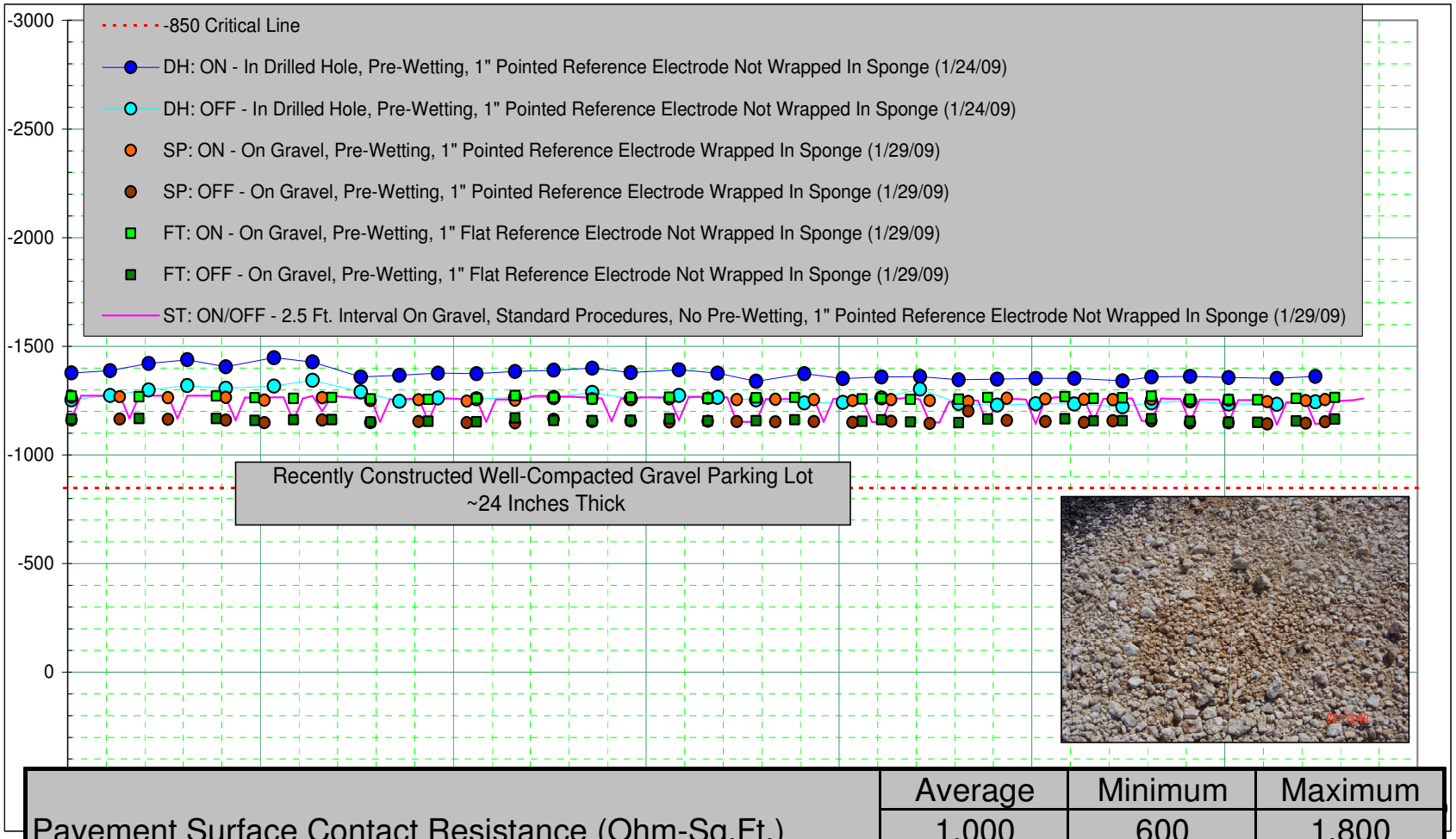
Characterizing Pavement – Field Tests: ASPHALT



SURFACE RESISTANCE

corrpro®

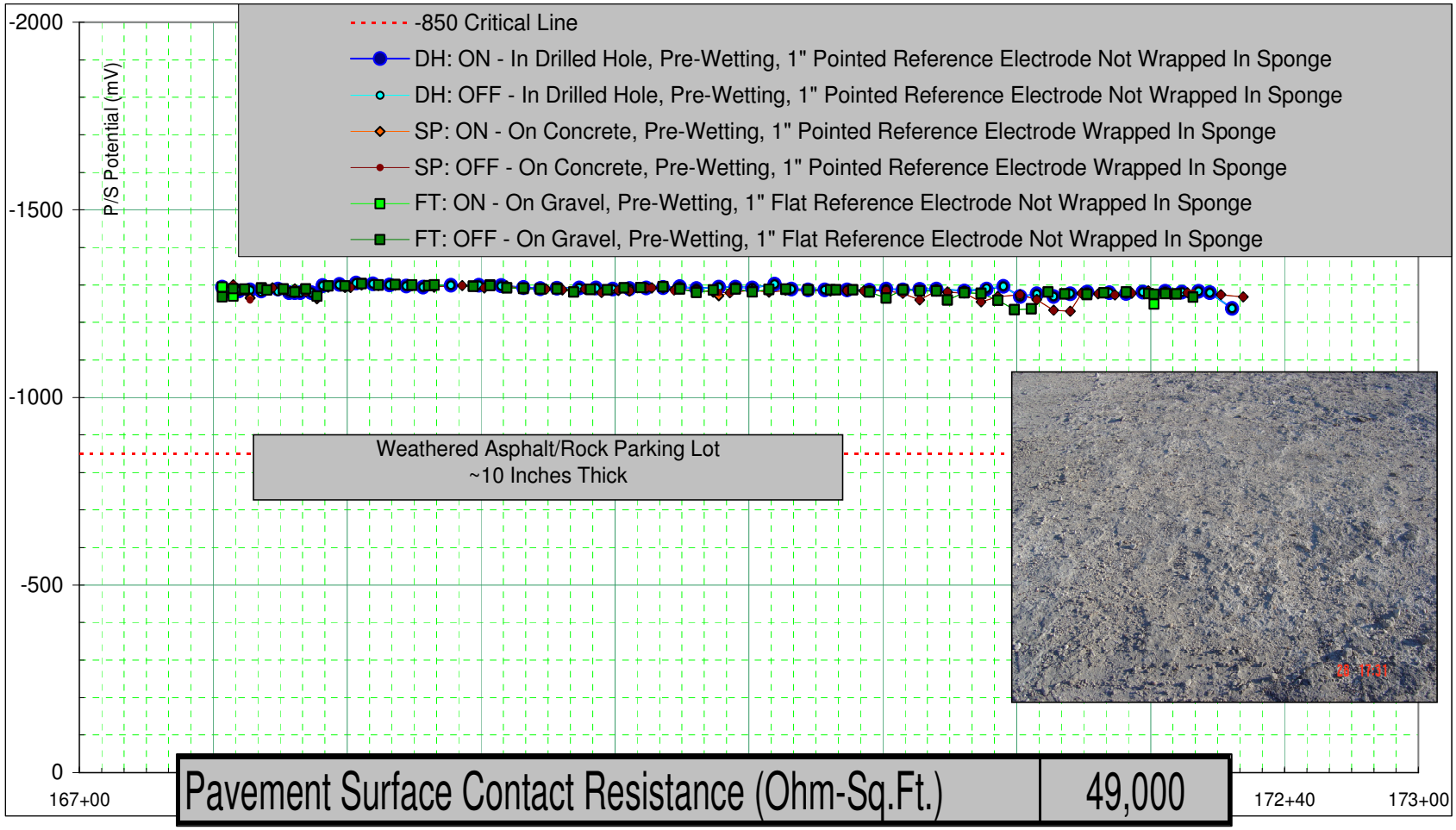
Holes vs. No-Holes: Well-Compacted Gravel



	Average	Minimum	Maximum
Pavement Surface Contact Resistance (Ohm-Sq.Ft.)	1,000	600	1,800

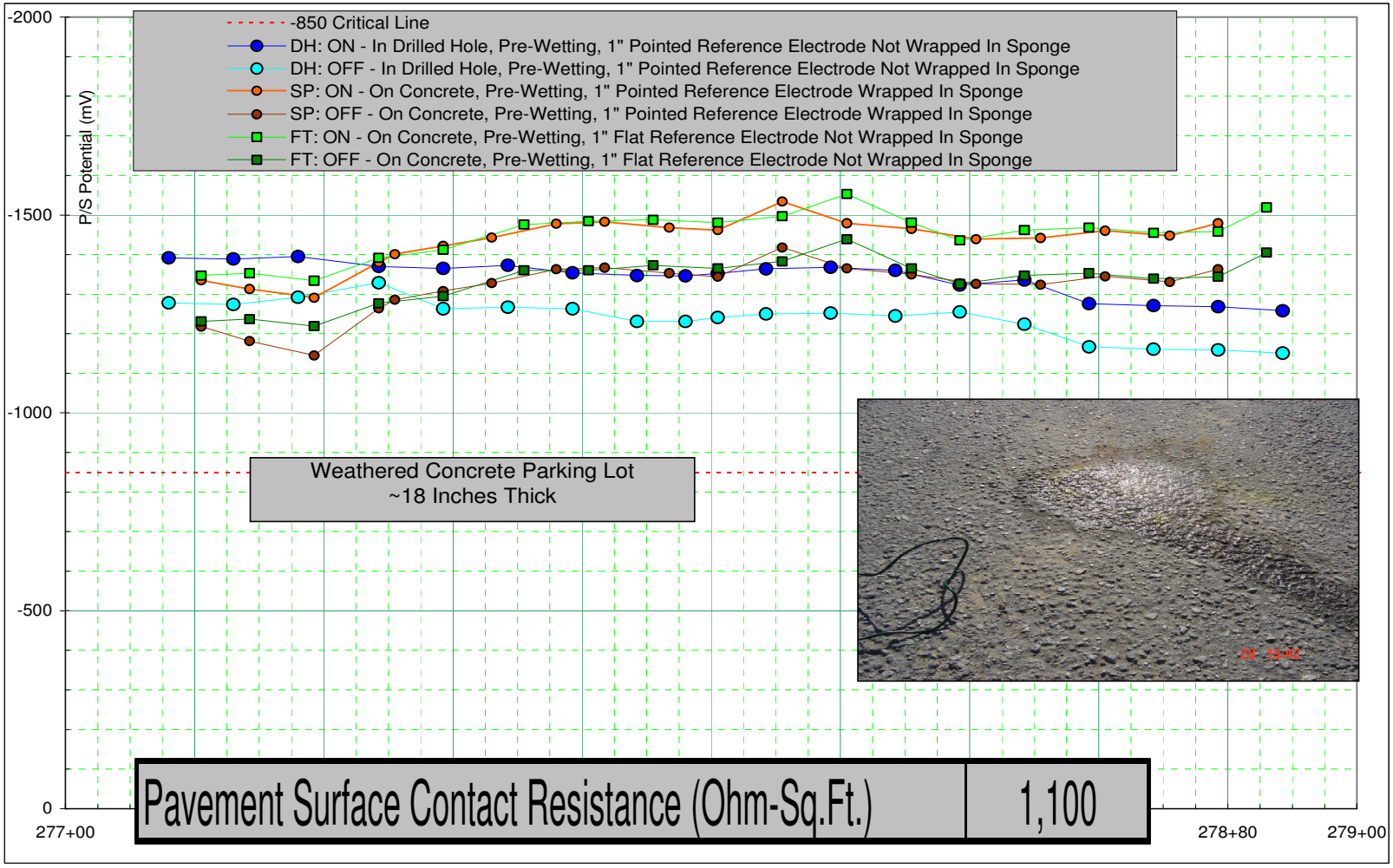
corrpro®

Holes vs. No-Holes: Weathered Asphalt/Rock



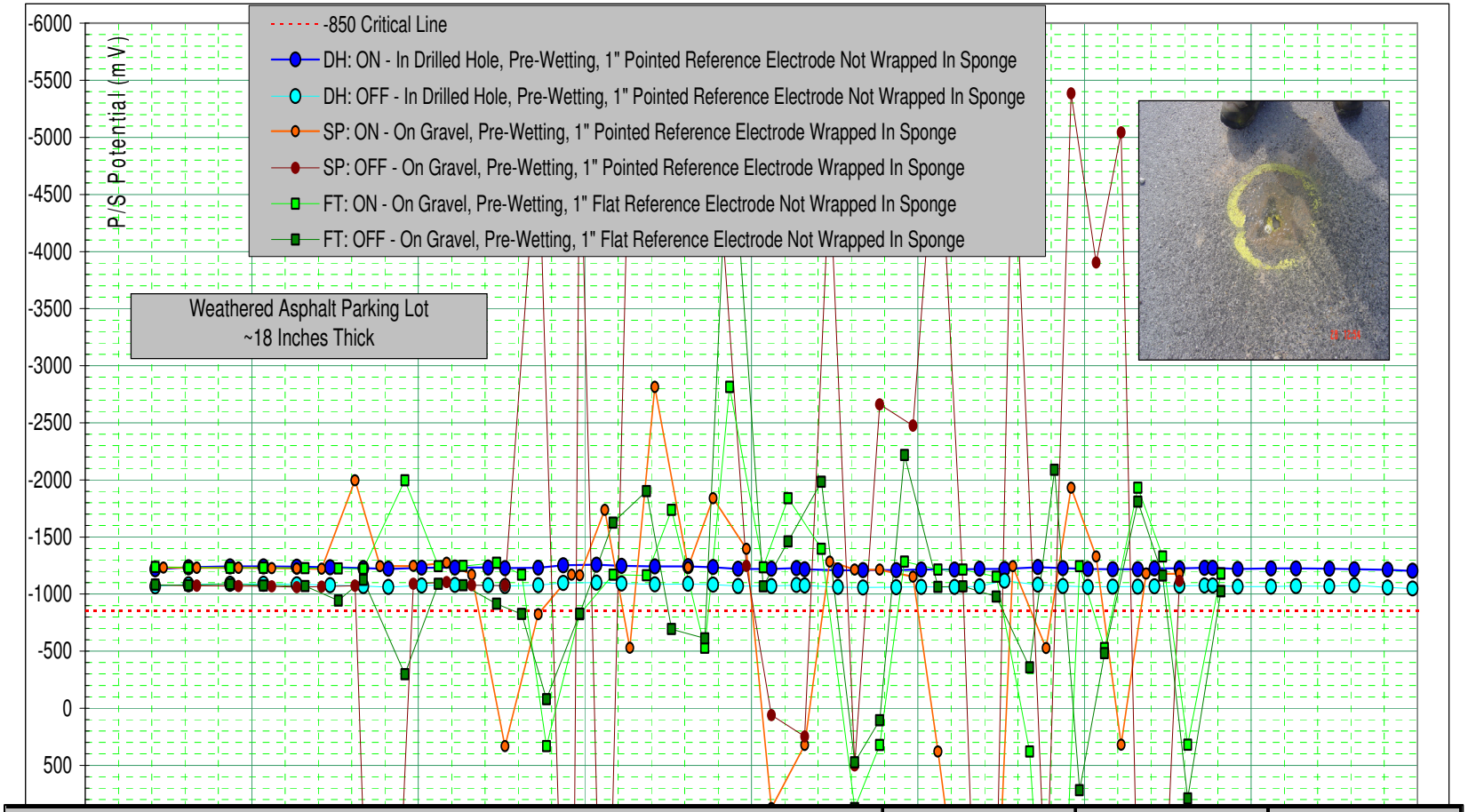
corrpro®

Holes vs. No-Holes: Weathered Concrete



corrpro®

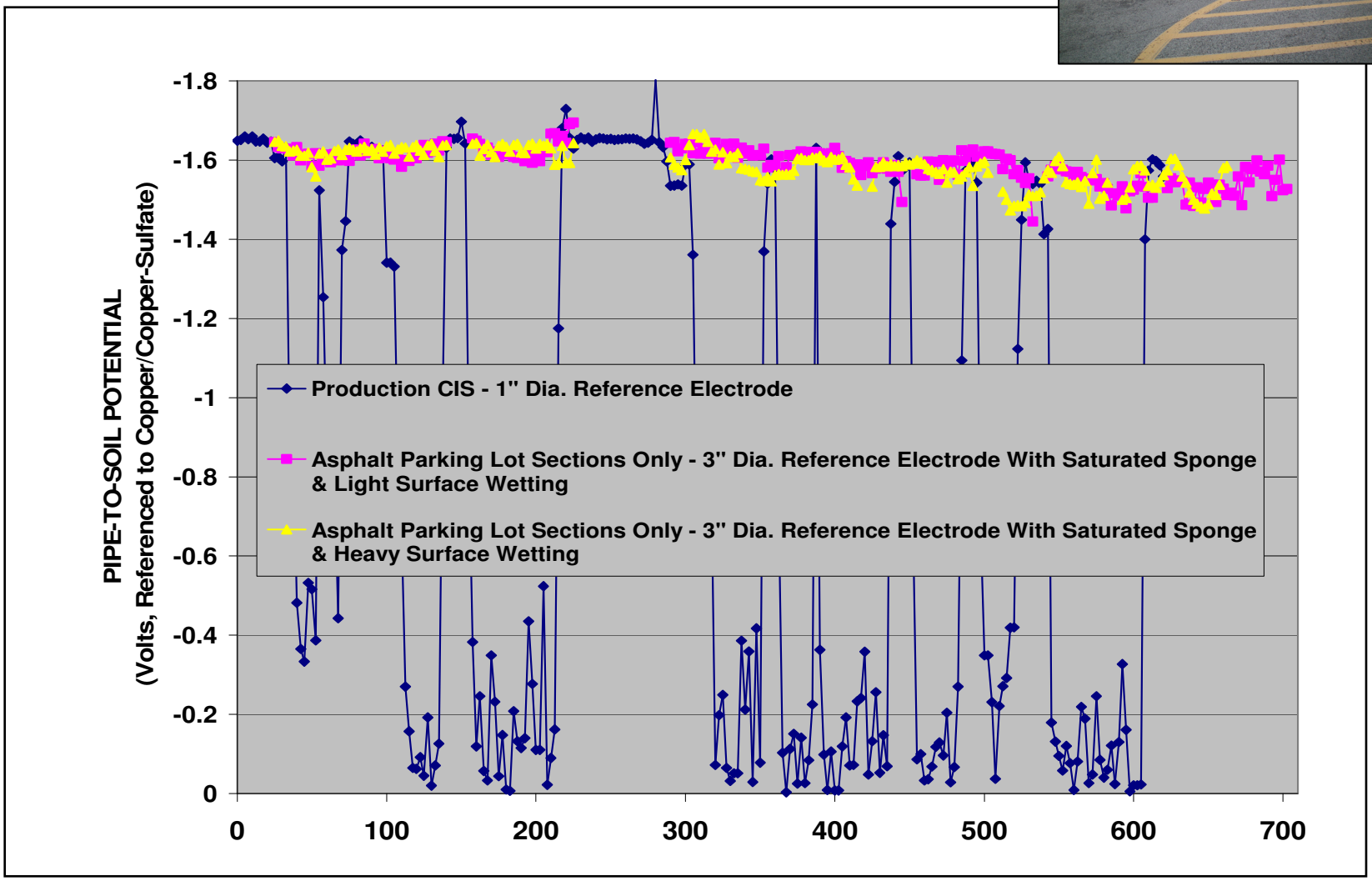
Holes vs. No-Holes: Weathered Asphalt



	Average	Minimum	Maximum
Pavement Surface Contact Resistance (Ohm-Sq.Ft.)	2.E+08	6.E+07	3.E+08

corrpro®

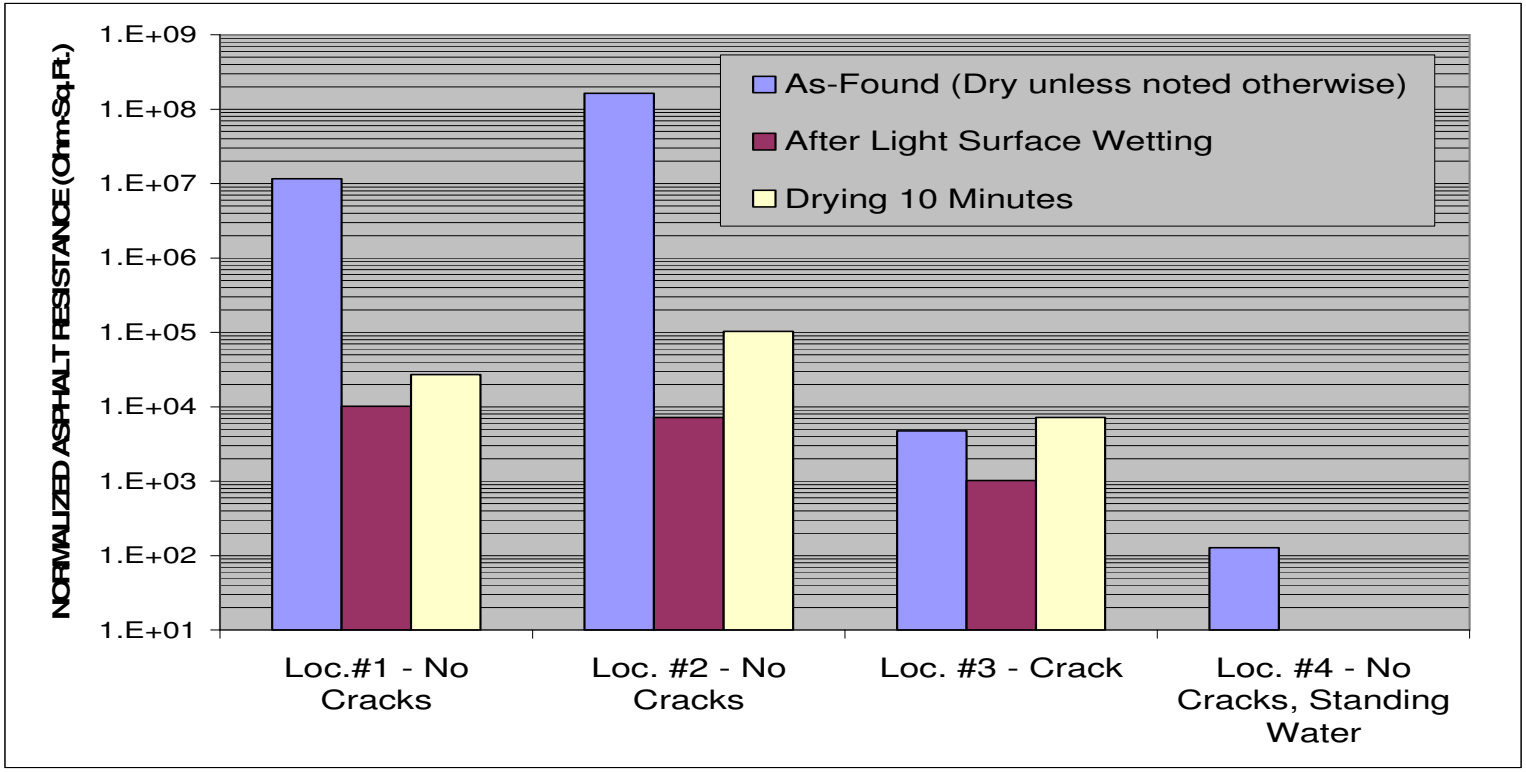
Asphalt Parking Lot: CIS



corrpro®

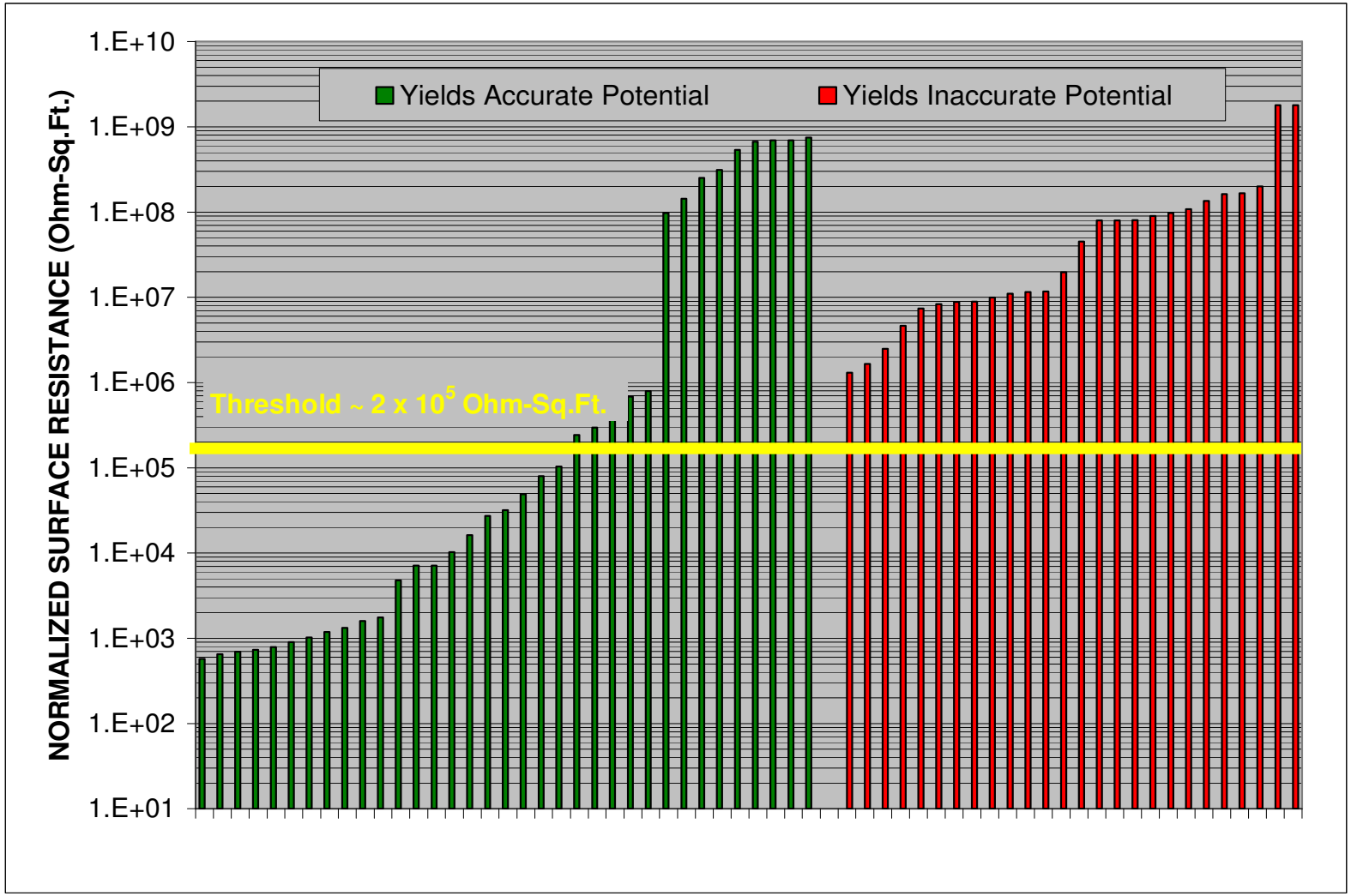
Asphalt Parking Lot: Resistance at Start of CIS

Light surface wetting with pressurized sprayer



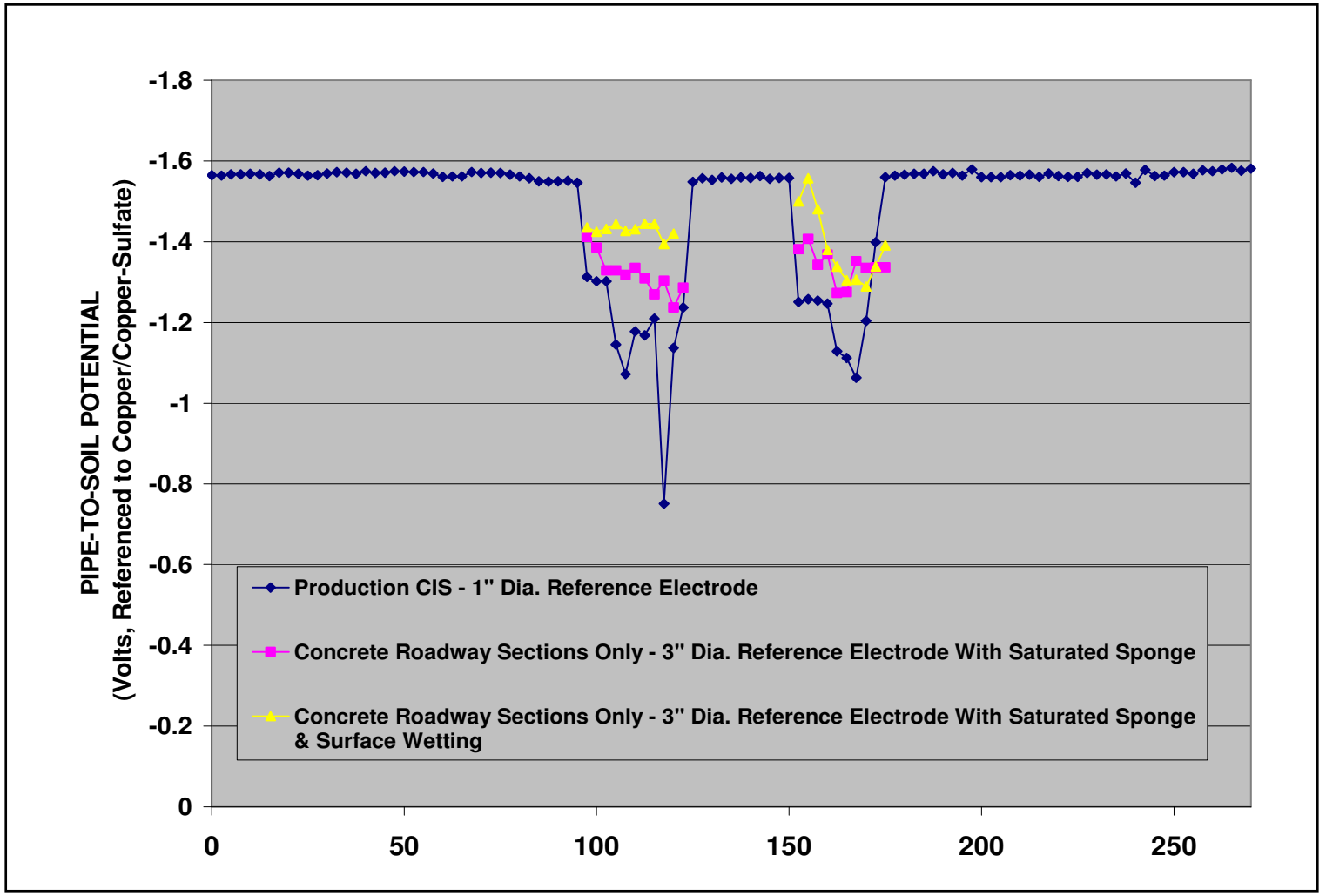
corrpro®

Surface Resistance Threshold for Asphalt & Gravel



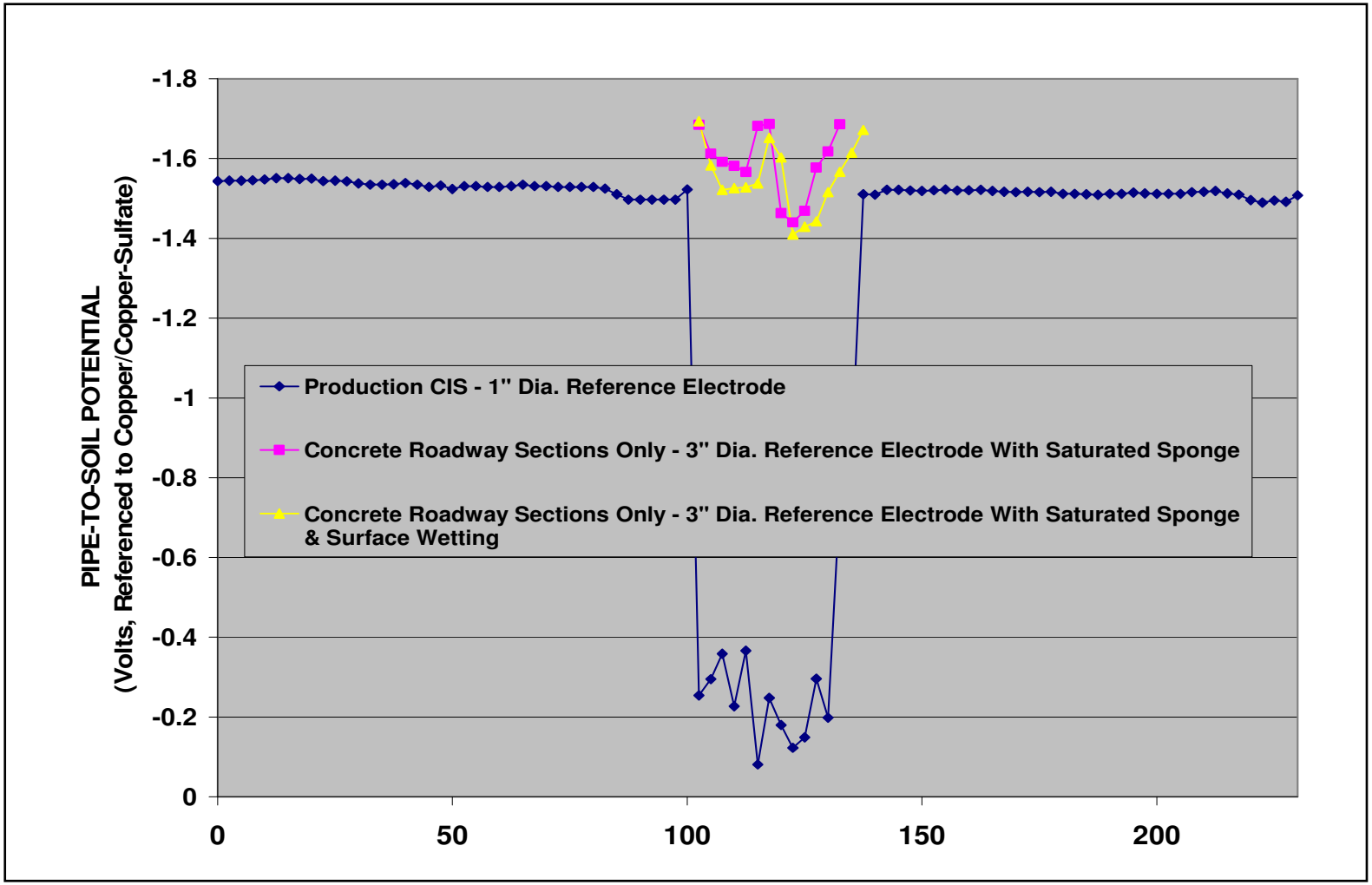
corrpro®

Reinforced Concrete Roadway: CIS



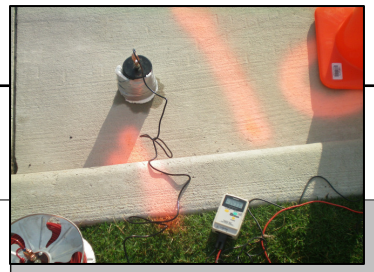
corrpro®

Reinforced Concrete Roadway: CIS



corrpro®

Concrete Paving: Potential vs. Time



corrpro®

Conclusions

Gravel & Asphalt:

- Simple, straightforward pre-survey surface resistance measurements can be used to determine if on-pavement potential surveys will yield accurate results
- A threshold of ~$2x10^5$ ohm-ft^2 has been set
- A standard 3” diameter reference electrode with wetted towel or sponge is adequate to minimize the effect of contact resistance

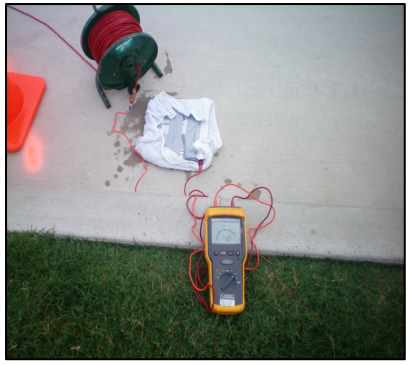
Concrete:

- No clear, consistent method for making accurate pipe-to-soil potential measurements without drilling holes
- On-pavement DCVG techniques seem plausible – additional field testing is planned to conclude this item

corrpro®

Test Procedures Outline

- Measurement options when paving is encountered
- Visual guides relating paving conditions to measurement reliability
- Electrical measurement types
- Instrumentation (commercially available equipment)
- User-friendly electrical measurement procedures, set-up schematics and photos
- Measurement interval frequency
- Error sources and impact on ECDA analysis
- Validation measurements, e.g. measurement sampling through drilled holes
- Data reporting



corrpro®

Thank you

We will be pleased to answer your questions.